

# **PAVEMENT TYPE SELECTION PROCEDURES**

**IN VIRGINIA**

**VERSION 3**

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Pavement Design and Evaluation  
Designing Today for Tomorrow's Strains



## **DEFINITIONS:**

### Pavement Type Selection:

The process of determining the most cost effective pavement type that is capable of supporting the anticipated traffic under the prevailing environmental conditions, and provides the safety and comfort to the traveling public of Virginia highways.

### Pavement Design:

The process of selecting a practical and economical combination of materials of known strength and adequate thicknesses to support anticipated traffic under the prevailing environmental conditions. The process also provides for the determination of alternate structures using a variety of materials and construction procedures.

### Design Period:

The period of time elapsed as initial pavement structure deteriorates from its initial to its terminal serviceability. This is used to determine the pavement structure (typically 30 years) for both asphalt and concrete pavements, interstate and primary roads. (See “Guidelines for 1993 AASHTO Pavement Design” (May 2000) for more details).

### Analysis Period:

The period of time for which the life cycle cost analysis is conducted and used for economic analysis. During this analysis period, AASHTO recommends at least one major-rehabilitation activity. Therefore, VDOT has adopted a 50-year analysis period for all pavement types.

## **INTRODUCTION**

This document will briefly describe the procedures used by VDOT in selecting a pavement type for a project.

### **Pavement Evaluation**

For projects where the existing pavement will be utilized, the structural and functional condition of the pavement must be determined. The following evaluation processes may be utilized:

- a. Falling Weight Deflectometer Testing for Structural Capacity
- b. Visual Condition and Patching Survey
- c. Pavement Coring and Subgrade Boring
- d. Laboratory Material Testing

Details of VDOT's pavement evaluation procedures are contained in the document titled "Guidelines for Project Evaluation and Pavement Design".

### **Pavement Design**

For projects requiring a functional or structural improvement, VDOT's Pavement Designer will perform pavement designs as well as specify any maintenance to be performed. The pavement designs will be based on current AASHTO procedures. The Pavement Designer will use data collected in Pavement Evaluation phase to determine the current pavement condition and future requirements based on anticipated traffic. Where possible the Pavement Designer will develop multiple alternatives for a project in order to perform life cycle cost comparisons. The Pavement Designer should consider changing maintenance approaches (more vs. less patching), changing overlay thickness, changing milling thickness, changing materials, etc. For new projects, the pavement will be designed to accommodate future traffic based on the project's location and materials.

The following sections describe the design considerations and methods used by VDOT Pavement Designers.

#### Design considerations:

For all projects, most of the following design considerations should be incorporated into a pavement recommendation:

- √ Pavement performance (Structural, functional, safety)
- √ Traffic – existing and predicted
- √ Roadbed soil
- √ Materials of construction
- √ Environment
- √ Drainage
- √ Reliability
- √ Life cycle costs

#### Design Methods:

In Virginia, two pavement design methods are normally used. For Interstate, Primary and High-Volume Secondary Routes, the AASHTO Pavement Design Approach is required. For Low-Volume Secondary and Sub-division streets, the Virginia and AASHTO methods are acceptable.

#### Input parameters

##### *AASHTO Method*

An empirical method based on the AASHO Road Test. The following parameters are needed to develop a pavement design for flexible pavements:

- a. Resilient modulus for the subgrade
- b. Cumulative ESAL'S for the design life of the pavement.
- c. Drainage coefficient for unbound materials
- d. Reliability level
- e. Overall standard deviation
- f. Serviceability

For concrete pavement additional parameters are used:

- a. Modulus of subgrade reaction
- b. Elastic modulus of concrete
- c. Modulus of rupture of concrete
- d. Load transfer factor

These parameters are documented in the "AASHTO Guide for Design of Pavement Structures" (Rev. 1993) and VDOT's "Guidelines for 1993 AASHTO Pavement Design" (May 2000.). Several programs including DARWin (Pavement Design Analysis and Rehabilitation for Windows) and WinPAS are used.

##### *Virginia Method*

- a. California Bearing Ratio (CBR)
- b. Resiliency Factor

- c. Traffic is terms of the Equivalent Single Axle Loads (ESAL's) also known as 18 kip (18,000 Lbs Single Axle Loading) projected to the mid design period of 30 years for primary and interstate roads.
- d. Thickness Equivalency Factor, which is the relative index of strength the material contributes per inch of pavement depth. It can be defined as the ratio of the strength of one inch thickness of the material to that of one inch of asphalt concrete.

These parameters yield a structural number or total thickness of pavement. The determination of the individual layer thicknesses is achieved using the thickness equivalency factors and the most practical layer thickness for constructability.

The computer program Flex-pd 2000 allows the designer to input the cost of each material and to choose from a list of different materials.

The above procedure is documented in the "Flexible Pavement Design Guide for Primary and Interstate Roads in Virginia" (Rev. Jan 1995) also documented in the "Pavement Design Guide for Subdivision and Secondary Roads in Virginia" (Rev. August 2000).

Output parameters:

Output for Flexible Pavement, whether from the Virginia Method or AASHTO, yields a structural number for the total pavement and the individual layer thicknesses. For rigid pavement design, AASHTO yields a slab thickness for concrete pavement.

**Initial Cost Estimates**

Cost estimates for paving materials are obtained from the Information Systems Division using their computerized Engineering Estimate System. This system drives unit costs from a historical database of bid tabulations. For an updated cost estimates on unique projects that do not match the information in the data base, Construction Division is contacted and estimates are verified.

**Life Cycle Cost Analysis: (LCCA)**

For projects that meet the criteria for conducting a life cycle cost analysis (LCCA), it is used to examine the economic worth of each pavement type. It consists of the initial cost estimate of the paving materials and the future maintenance activities necessary to maintain the road at an acceptable serviceability level to the traveling public. These activities cover maintaining the pavement quality, namely smoothness and safety in terms of non-skidding, and the structural capacity, namely the elimination of cracks, faulting, potholes, and rutting. Present worth

approach is used to represent the translation of specified amounts of costs or benefits occurring in different time periods into a single amount at a single instant (usually the present).

Since pavement type selection is not an exact science but one which the highway engineer must make an engineering judgment a difference up to 10% in Life Cycle Cost Analysis (LCCA), net present worth, shall not be considered as the sole reason for selecting pavement type. In this case engineering judgment shall be used to select pavement type.

For more information on VDOT's LCCA approach, please see the document titled "Guidelines for Life Cycle Cost Analysis" (June 2001).

**Justifications:**

A combination of LCCA and engineering judgment are documented to finalize the pavement type selection. When the net present worth for both types of pavements is within 10% other factors are examined. These factors are:

- Traffic,
- Soils characteristics,
- Weather,
- Construction consideration,
- Recycling,
- Cost comparison,
- Performance of similar pavements in the area,
- Adjacent existing pavement,
- Conservation of materials and energy,
- Availability of local materials or contractor capabilities,
- Traffic safety,
- Incorporation of experimental features,
- Stimulation of competition,
- Municipal preference,
- Participating local government preference, and
- Recognition of local industry.